GUIDE TO PRE-OPERATIONAL FIELD PROCEDURES FOR MOSQUITO CONTROL PROGRAMMES

May 1970
(revised 1974)

Ontario

Ministry of the Environment

The Honourable
William G. Newman,
Minister

Everett Biggs,
Deputy Minister

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Biology Section
Water Quality Branch

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The following guidelines are intended to assist mosquito abatement officers and field crews involved with the planning of large-scale programmes to control mosquito larvae. The procedures put forward are necessary for a number of reasons:

(a) Currently available larvicides are non-specific and can effect a variety of invertebrate forms in addition to mosquitos. In most cases the parent material is short-lived in the water environment and degrades to compounds the biological effects of which are not completely understood. Present methods for evaluating long-term ecological changes are not sufficiently sensitive or comprehensive to provide evidence of absolute safety for any toxic material introduced to the environment.

(b) While it may be true in part that the more pesticide employed, and the greater the area covered, the better the results achieved, there comes a time with all pest control programs when increased use of chemical is not justified due to the diminishing returns received. Good planning and accurate surveying to locate major sources of mosquitos should help to establish the justifiable limits of larvicide use.

(c) Currently available larvicides do not retain acute larvicidal properties for more than a few days. Knowledge of the breeding habits of local mosquito populations is essential in order to ascertain variations in developmental periods between geographically-separated populations, and thereby to determine the need for spraying certain types of habitat at different times of the spring and summer periods (viz. Open swamp populations, woodland pool populations).

Having determined these 'gross' differences between populations it may be necessary to verify such distinctions in future years but it will certainly be necessary to examine mapped habitats each year to determine the optimal time for respraying.

(d) In some instances it may not be economically possible to spray all wet areas supporting larvae. Presuming the entire control zone is considered a potential threat to neighbouring residential areas, (i.e. within 3-5 miles of a heavily populated district), then considerable effort is necessary to locate areas of high larval density which can be assigned high priority for treatment.

(e) If these procedures are followed it is reasonable to assume that the best possible results will be achieved with the chemicals and methods currently available. It may then be possible to assess, through an opinion poll or adult-trapping technique, the degree of success achieved and whether this is compatible with the effort and cost involved.

INTRODUCTORY NOTES

For those persons not previously involved with mosquito abatement programs it will be advantageous to learn some fundamental points relative to mosquito biology and ecology. There are four stages to mosquito development; egg, larva, pupa and adult. When and where eggs are laid, the time of hatching, the rates of development of larvae and pupae and, perhaps most important of all, the tendency for biting humans are all dependent on the particular species concerned. However, in Ontario the majority of mosquitos deposit eggs in wet areas during the frost-free period of the year (May-October) and these eggs either remain dormant till the succeeding year (uni-voltine species) or may produce second or third generations in the same year if favourable meteorological conditions exist (multi-voltine species). Early spring mosquito populations, which frequently produce

the most severe outbreaks of biting, particularly in those years having dry summers, are mainly composed of the former type and many abatement programs will be designed exclusively to control these early species.

In theory, any sheltered body of shallow, standing water will be potential mosquito-breeding habitat. These include swamps, ponds, snow pools, flooded river banks, ditches, rain barrels, discarded tires and a myriad of natural or man-made water containers. In actuality, since climate topography and species-composition vary with geographical region and each mosquito species has distinct habitat preferences, the characteristics of major breeding grounds will vary between areas and certain types of habitat will be found to predominate. In Ontario, woodland mosquitos are particularly problematical. Larvae of the spring species may frequently be located in small snow-pools scattered between the trees in deciduous woodland or in small ponds with tall surrounding vegetation. The larvae of the species may be located in swampy sections of open, agricultural land or in ditches along roadsidesor between emergent vegetation at the sides of ponds, lagoons and small lakes. As a general rule larvae will not be located in running water, even if the flow is very gentle, or in exposed bodies of water where strong breezes cause ripples which interfere with surface breathing. However, mosquitos are not entirely predictable with respect to egg-laying and careful examination of each and every habitat is the only reliable way in which infestation can be confirmed.

Mosquito larvae go through four stages of development known as instars. Moulting occurs between instars and allows for a progressive increase in larval size. Since the majority of current larvicides are not capable of killing eggs or pupae, it is important that survey crews grow accustomed to recognizing the various instars and to estimating the optimum time of treatment for a given breeding area. Development is seldom found to be precisely in phase, so that treatment of 1st and 2nd instar larvae may be too early to ensure that all eggs have hatched. On the other hand, if the majority of larvae have reached their 4th instar treatment may come too late to avoid a high degree of pupation. In general, the optimum time for chemical treatment is when the majority of larvae are in their late 3rd instar. However, it should be emphasized that under warm weather conditions larval development may be quite rapid with significant changes occurring every 24-hours or less. As a consequence it is important to organize field surveys so that checks can be made at frequent intervals up to the time of chemical application.

PROCEDURE

1. Document areas from which complaints have been received concerning mosquitos and endeavour to substantiate claims that a control program is required.

2. Obtain topographical maps with a minimum scale of 1:25,000 which include the entire control zone and depict surrounding terrain up to a distance of at least five miles from the centre of the populated zone. Check with the Aerial Photography Section of the Department of Energy, Mines and Resources* to see if recent photographs of the areas are obtainable and if so, either purchase a set or avail of the Department's facilities to examine them.

3. Using the maps and where possible, aerial photographs, shade in or otherwise suitably designate, areas of wetland, and distinguish these from upland areas and dry or agricultural land.

4. Obtain <u>all</u> pertinent information from maps and photographs. Where photographs have been taken at suitable seasons distinguish open swamp from swamp which is partially covered by vegetation. Note all access routes which may facilitate ground treatments. In particular mark swampland in proximity to major drainage systems where contamination of fish-producing waters through runoff or spray drift may occur.

5. Determine the number of field spot-checks required in order to obtain reasonable coverage of all wet areas. In each case, this will be dictated by:

* *Or the Ontario Ministry of Natural Resources*

a. numbers and sizes of wet areas

b. nature of the habitat e.g. woodland pools, flooded fields, grassy swamps etc.

c. accessibility

6. Determine manpower and equipment (vehicles, waders, dippers etc.) requirements. See Page 11.

Survey guidelines

Due to the infinite variety of habitats which may be contacted it is not realistic to delineate survey procedures which should be rigidly adopted under all circumstances. The following suggestions are based on the experiences of Ministry of the Environment personnel who have been involved with mosquito habitat surveys in both rural and surburban areas of the province. In all cases, however, it should be the responsibility of the Program Co-ordinator to define survey procedures for the control zone in question which take into account local characteristics of climate, land-use and topography.

1. How to perform a spot check for larvae

A spot check is an examination at a single point, it may be the only check made in a small pond or one of many performed throughout a large continuous swamp.

a. Approach the water slowly taking advantage of any available cover; if possible face the sun to avoid shadows (larvae descend rapidly when disturbed and are more difficult to collect). Using the enamel dipper, and reaching as far away as possible quickly scoop up a sample of water. Make a mental note of the number of larvae contained, repeat the operation several times at about 10 ft. intervals and record the average number for that check point.

NOTES: In most cases there is little value in standardizing the number of dips taken at each check point. The surveyor should be satisfied that his sample is representative of that general area. However, use the eyes as well as the dipper, look for dense clumps of larvae under bushes or beside sunken logs.

b. Note the instars present. If more than one instar is evident estimate the relative abundance of each in percent (%) of the total.

NOTES: If uncertain as to which instars are present obtain a representative sample in a 1 oz. glass vial and have a fellow surveyor (or other experienced person) make the identification. Label the jar with the date and check point location.

c. Record the average water depth at the check point, mark the spot on the survey map, note details such as vegetation cover (tall trees, surrounding bushes etc), and estimate the surface area of the entire water body. For future reference leave a piece of surveyors tape attached to a conspicuous object to mark the check point. If check points are assigned numbers write the appropriate one on the tape with a waterproof marker.

d. If larvae are mostly 1st or 2nd instar, record the water temperature (but only do this between the hours of 11 a.m. and 3 p.m. when maximum day-time temperatures can be expected).

2. How to determine the appropriate intensity of surveying

While mosquito habitats vary considerably in nature there are some major distinctions which should be recognized by survey personnel since they effect both surveying and treatment practices. Firstly, wetlands may be an assemblage of small pools randomly located over the landscape or may be characterized by a single expanse of shallow water covering many acres. Naturally, there are numerous situations which fit somewhere between the two. An experienced surveyor will probably decide that a single check point in each pool constitutes adequate coverage where surface areas are 2-3000 sq. ft. or less. For larger areas the number of check points might be increased proportionately or adjusted in accordance with the degree of similarity of vegetation cover, water depth, sediment type and so forth. Once again no firm rules can be established, but as knowledge of local mosquito populations increases it will be evident that larvae have distinct habitat preferences and this will help to expedite surveying and reduce the errors associated with predicting the existence of larvae throughout larger expanses of water which cannot practically be be surveyed in their entirety. However, initial surveys of newly established mosquito control zones must be extremely thorough and should be designed to minimize uncertainties relative to the extent of infested wet areas.

Surveyors should be well acquainted with the various types of larviciding operation being considered because chemical application procedures may indirectly effect the intensity of surveying required. For example, knap-sack sprayers are well suited to treatment of isolated swampy areas or woodland pool habitats and may be best employed by two-man crews comprised of a sprayman preceeded by a surveyor who checks each pool for larvae before a decision to treat is made. When

this thechique is to be adopted pre-operational surveys in areas with many small pools may be confined to a representative sample to confirm that larvae do indeed exist in that general habitat and to monitor the progress of larval development. Examination of each pool may be deferred until treatment time. In the case of an extensive swampy area a decision may sometimes be required as to whether to use ground treatments or to employ more costly airborne equipment. Before committing the latter equipment to the job it will be important to ascertain that larvae are actually present throughout the entire area and not confined, as is often the situation, to the more sheltered spots around the periphery which could be efficiently and economically treated from the ground.

3. Surveys should commence early in the spring as soon as 1st instar larvae are in evidence. Check-points not exhibiting larvae at first should be revisited at about 4-7 day intervals to ensure that late hatching does not go undetected.

4. As a general guide, anything less than 1 larva per 2 dips might suggest that chemical treatment is not justified, but this will, of course, depend on various factors including the extent of the wet area concerned and its proximity to residential areas. Waterbodies consistently producing 1 or 2 larvae per dip may be considered moderately infested and should be marked for control with second order priority; anything in excess of 2 constitutes heavy infestation and should be marked for control with top priority.

5. The size of the control zone will depend on the area of land requiring protection from mosquitos, the diposition of the human population and the locations of potential breeding areas. As a rule abatement programs should be designed to substantially reduce larvae situated adjacent to the

human population and throughout a surrounding buffer zone of one or two miles radius. Most townships, municipalities or other abatement groups will have limited resources of manpower, equipment and funds and will face the task of providing a satisfactory level of control within these limitations. As a result it may not always be possible to meet the needs of the entire human population. However, it is strongly recommended that all operations proceed outwards from the centre of the control zone to the the maximum distance possible. Any attempt to compromise by spreading available resources thinly over a large predetermined control zone will likely produce unsatisfactory results and must be discouraged at all costs.

6. In most residential areas, and in some recreational districts, breeding sites will be found which can be substantially reduced or eliminated by improved land drainage. Surveyors should mark such locations and communicate with the appropriate local drainage engineer to ensure that steps are taken to undertake the necessary modifications to the drainage network. Some small pot-holes and ponds may simply require filling with earth to eliminate them completely.

7. Some larval habitats may be too small to justify aerial treatments but too inaccessible to permit ground application due to dense brush and other obstructions. These locations should be recorded on the survey map with a view to organizing the cutting of paths which will permit access by ground crews with granular chemical spreaders or knapsack spray equipment. Such activities may form the basis of winter works projects and can provide useful employment for survey personnel over the mosquito-free months.

In conclusion it must be emphasized that there is insufficient information at present to predict the outcome of mosquito abatement programs performed under Ontario conditions. Much remains to be learnt about the suitability of existing chemicals, formulations and application techniques for controlling larvae over large tracts of woodland-pool habitat which so frequently constitute the major breeding areas in this province. Few, if any, of the methods currently available have been developed, or adequately tested, under the particular climatic, topographic and ecological conditions which make up the Ontario environment. Much of this province is covered by natural bushland which provides ideal habitat for a variety of problematical woodland mosquito species. It is inconceivable on the basis of present knowledge that these populations can be reduced to a level where significant reductions in biting are experienced. However, in proximity to populated districts where bush areas have been substantially reduced or where agricultural land predominates, there is every reason to suppose that nuisance mosquitos can be substantially decreased providing the abatement authority concerned makes a firm commitment to adopt a thorough, scientific approach towards the problem.

As more information becomes available concerning improvements in mosquito abatement methodology, including pre-operational survey techniques, it is hoped to expand and update these guidelines accordingly. Should further advice or information be required on survey procedures or other matters relating to mosquito control programs contact your nearest Pesticides Control Officer at the local Ministry of the Environment office or write directly to:

Ontario Ministry of the Environment,
Pesticides Control Service,
1st St. Clair Avenue West, 3rd Floor,
Toronto, Ontario

SUGGESTED EQUIPMENT LIST FOR MOSQUITO HABITAT SURVEY PERSONNEL

- Pair of good quality hip or chest waders
- Set of rainwear
- Wrist-watch
- Thermometer (0-50^{o}C with metal case)
- 1 qt. enamel dipper with 4' handle marked in inches
- 2 lead pencils
- Note book (waterproof preferable)
- Up to six 1 oz glass vials
- Large scale map
- Compass (optional)
- Roll of coloured surveyor's tape